



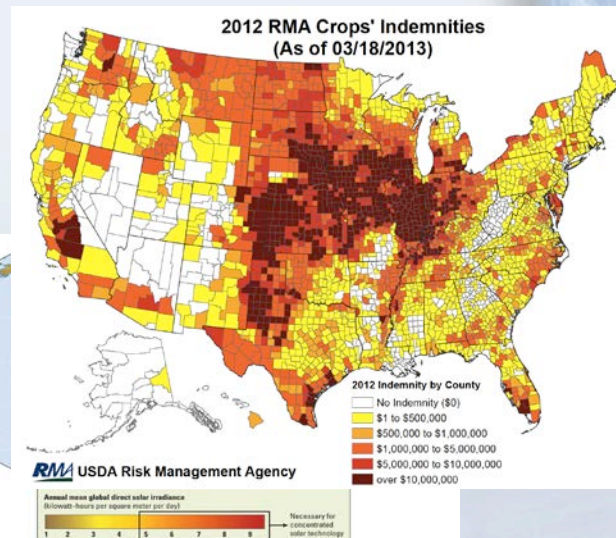
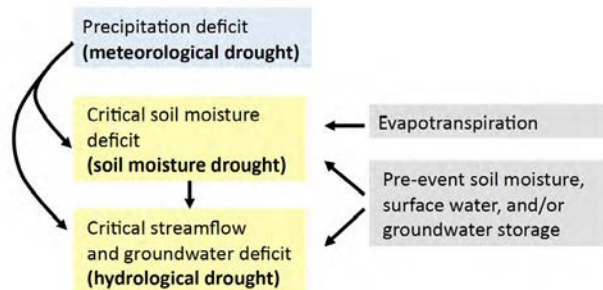
# The great drought of 2012 and a look forward

**Roger S. Pulwarty**

Director, National Integrated Drought Information System

NOAA Boulder CO

[roger.pulwarty@noaa.gov](mailto:roger.pulwarty@noaa.gov)



# Weather to Climate-A continuum and a deficit

Heat Waves

Storm Track Variations

Madden-Julian  
Oscillation

El Niño-Southern  
Oscillation + ?????

*Decadal Variability*

*Solar Variability*

*Deep Ocean  
Circulation*

*Greenhouse Gases*

30  
DAYS

1  
SEASON

3  
YEARS

10  
YEARS

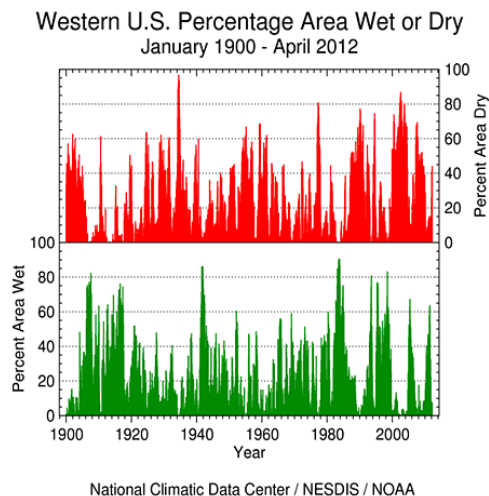
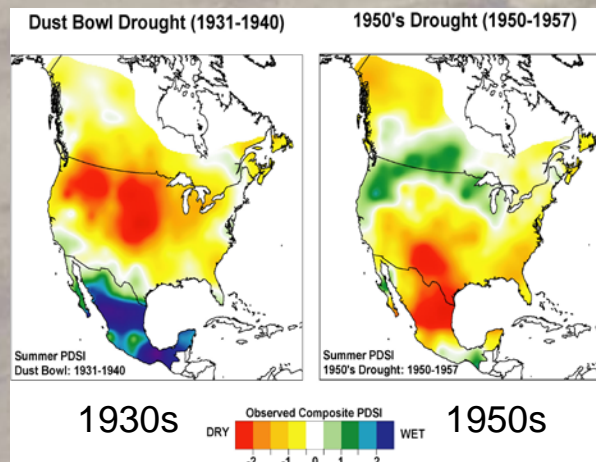
30  
YEARS

100  
YEARS

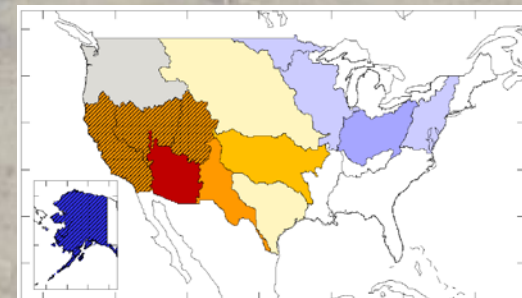
**SHORT-TERM**

**INTERANNUAL**

**DECADE-TO-  
CENTURY**

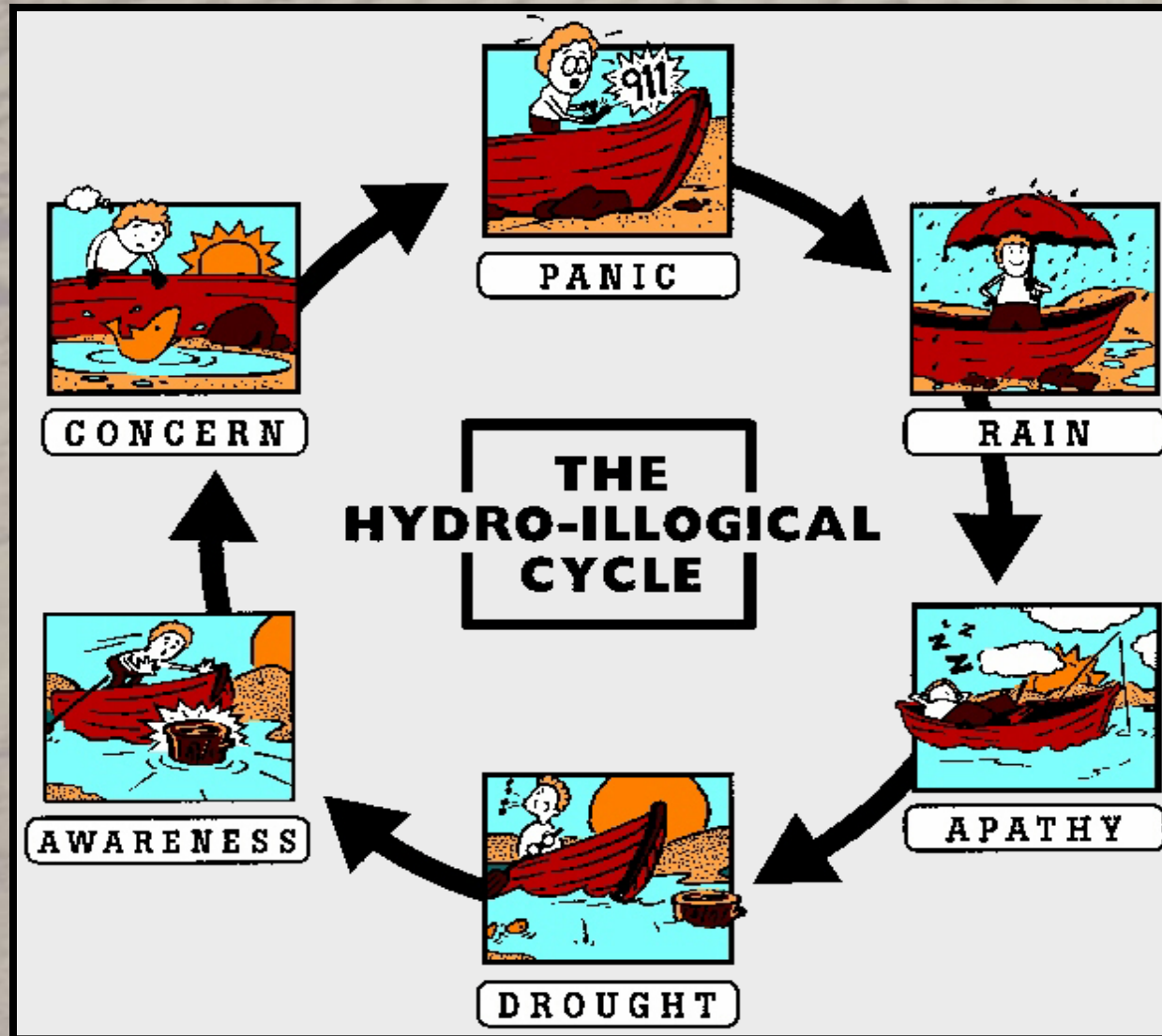


The future (2041-2060):  
where do the projections  
agree and why?

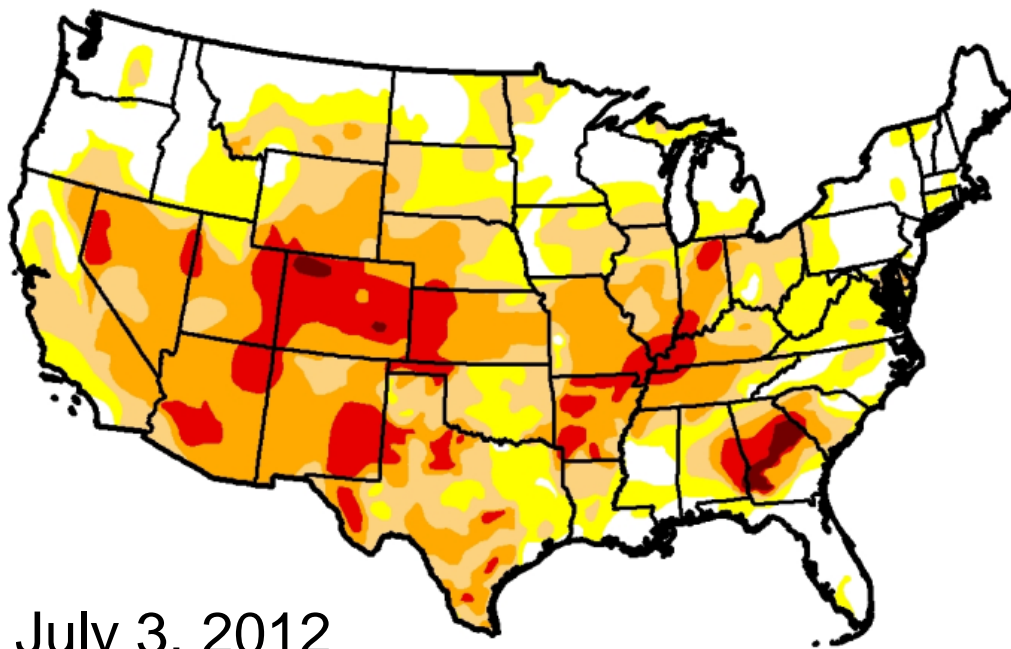




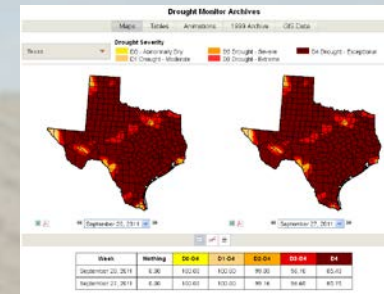
# Breaking the Hydro-illogical Cycle: An Institutional Challenge for Drought Management



**Crisis  
Management**



July 3, 2012



Over 60% of the contiguous United States in early September was suffering moderate to exceptional drought, nearly twice the land the previous year  
Most expansive drought since 1934

YEAR /MONTH % Area DRY

1934 May 73.1 Jun 74.1 Jul 79.9 Aug 77.5 Sep 70.2 Oct 67.7

1939 Dec 62.1 1954 Jul 60.4 Dec 59.5

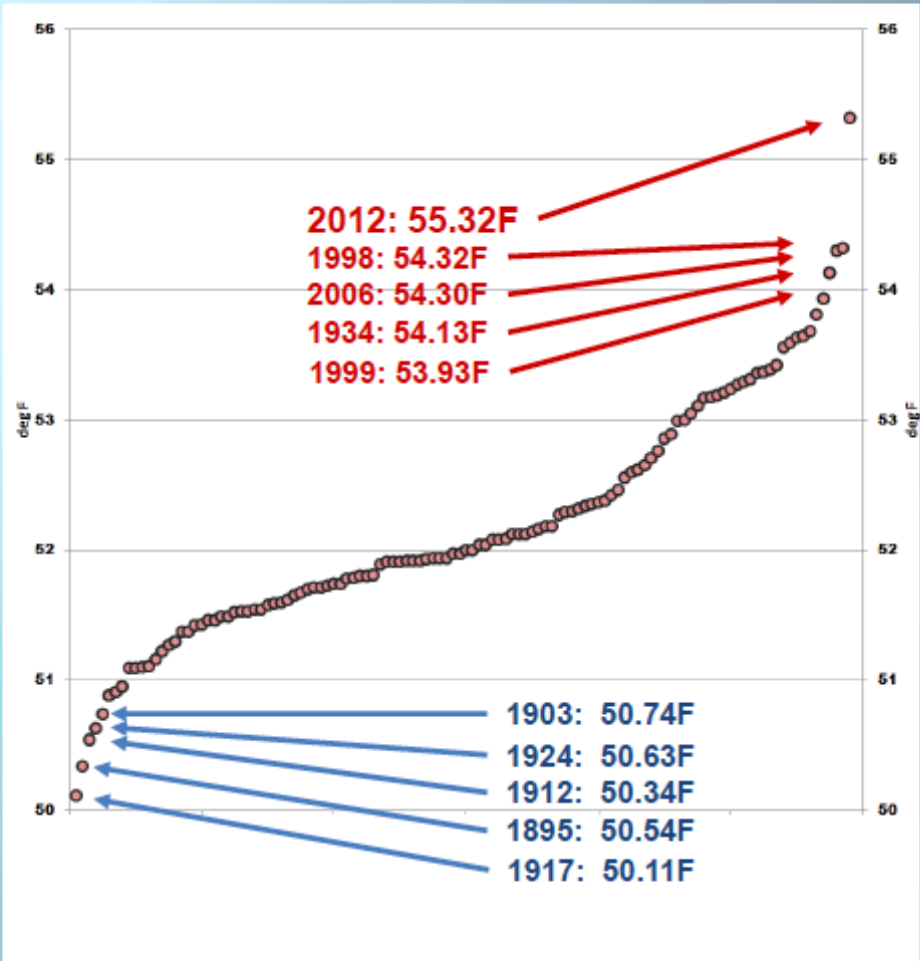
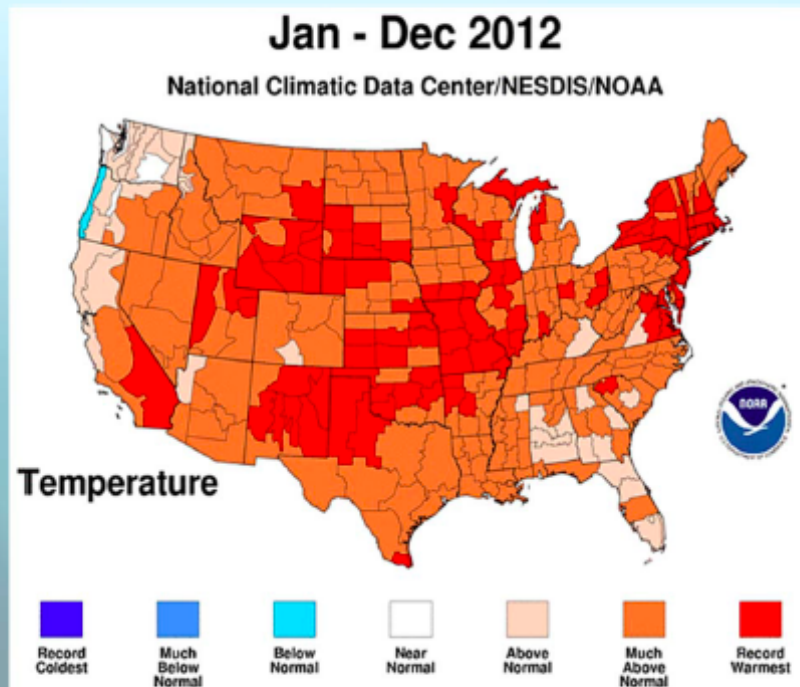
2012 Jul 62.8 Aug 60.0 Nov 60.0 December 61.8



# Warmest Year on Record for the Continental U.S.

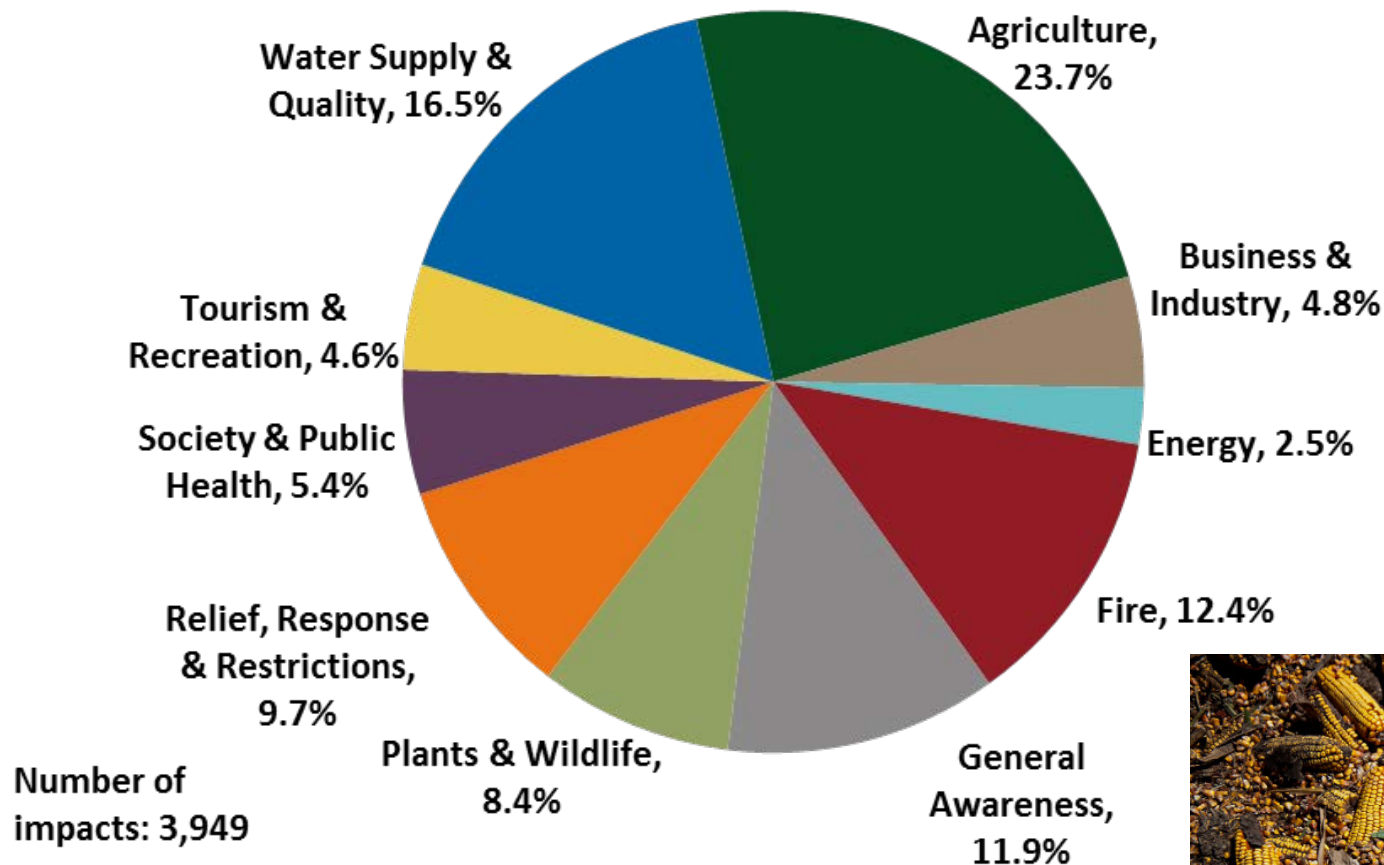
## NOAA

- **3.25F** above 20<sup>th</sup> Century average



# 2012 Drought Impacts by Sector: The diversity of impacts

Reports by category in the Drought Impact Reporter, January - August 2012



AON  
Benfield  
\$35b to Ag  
alone

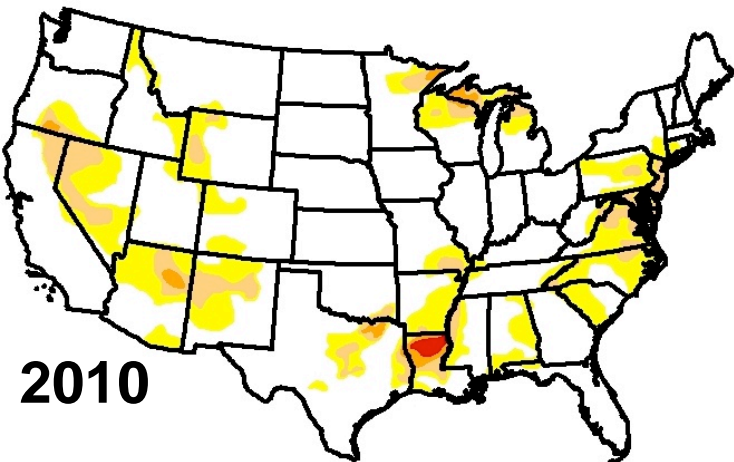
Sandy and  
Drought >  
\$100b?





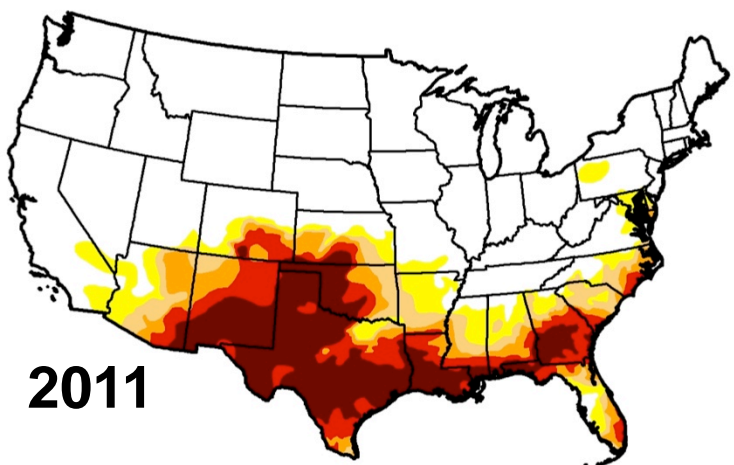
Crop	Unit	USDA projection/ estimate as of:		Change	Percent change
		5/10/2012	1/11/2013		
<b>Corn</b>	\$/bu	4.60	7.40	2.80	60.9
<b>Soybeans</b>	\$/bu	13.00	14.25	1.25	9.6
<b>Sorghum</b>	\$/bu	4.25	7.30	3.05	71.8
<b>Rice</b>	\$/cwt	15.8	14.9	-0.9	-5.7
<b>Wheat</b>	\$/bu	6.10	7.90	1.80	29.5
<b>Cotton</b>	Cts/lb	75.0	68.5	-6.5	-8.7





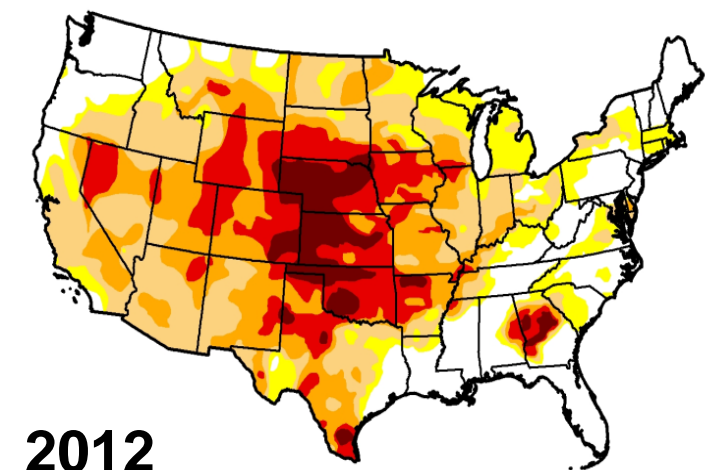
**How did we get here? Status and antecedent conditions**

**Is this drought like others? Why has it been dry/drier than normal?**



**What are the impacts and where did they occur?**

**What information is being provided and by whom?**



**How bad might it get and how long will it last?**

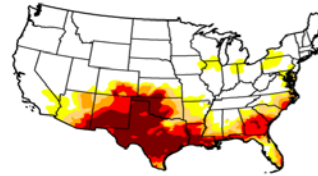
**Are information needs being met?**

**How are we planning for this year and for longer-term risks and opportunities?**

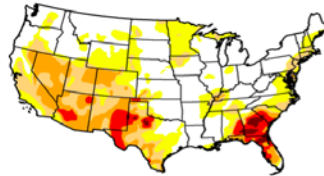




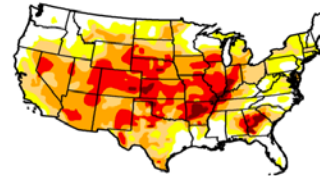
July 2010  
8% moderate  
to exceptional



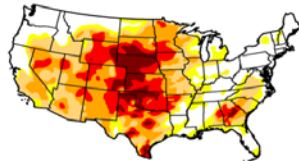
July 2011  
28% moderate  
to exceptional



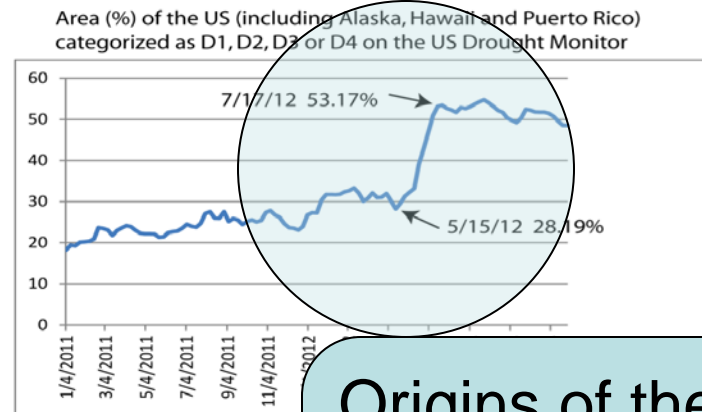
May 2012  
35% moderate  
to exceptional



July 2012  
64% moderate  
to exceptional



January 2013  
58% moderate to  
exceptional



**Figure 1. How did we get here? Antecedent conditions and status (So NDMC, 2013)**

Origins of the 2012  
Great Plains  
Drought-an  
interpretation

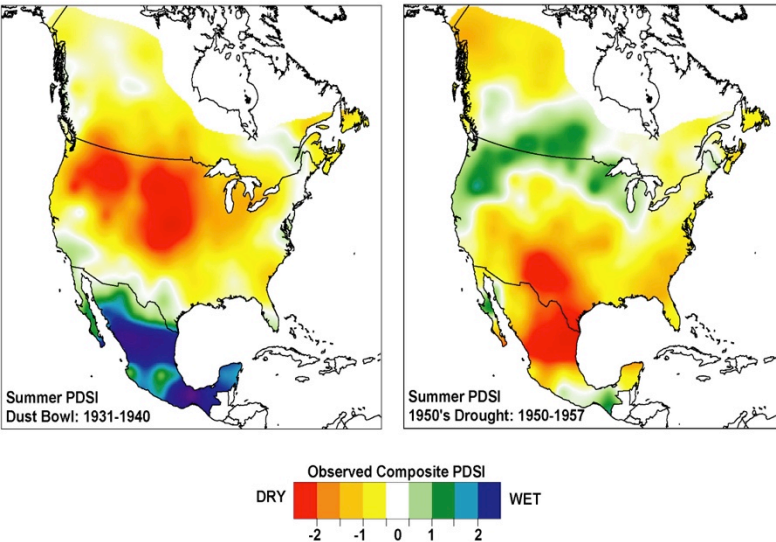
1930s

1950s

October 31, 2012

### Dust Bowl Drought (1931-1940)

### 1950's Drought (1950-1957)

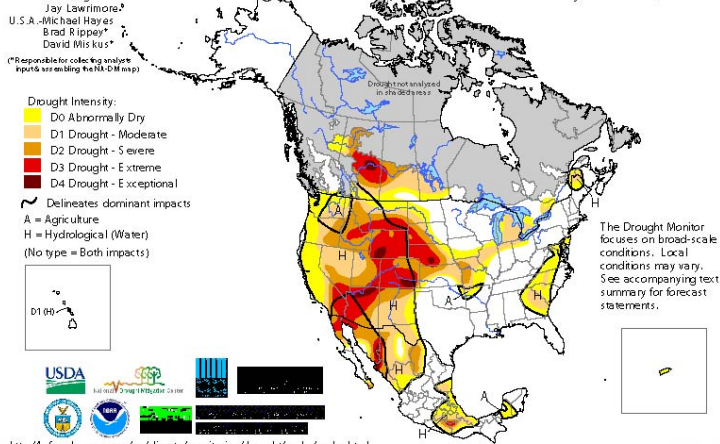


2002

## North American Drought Monitor

Analysts:  
Canada - Ted O'Brien  
Mexico - Miguel Cortez  
Ari Douglas  
Jay Lawrimore  
U.S.A. - Michael Hayes  
Brad Rippey  
David Miskus

November 2002  
Released: Friday, December 20, 2002



## North American Drought Monitor

October 31, 2012

Released: Friday, November 16, 2012

<http://www.ncdc.noaa.gov/nadm.html>

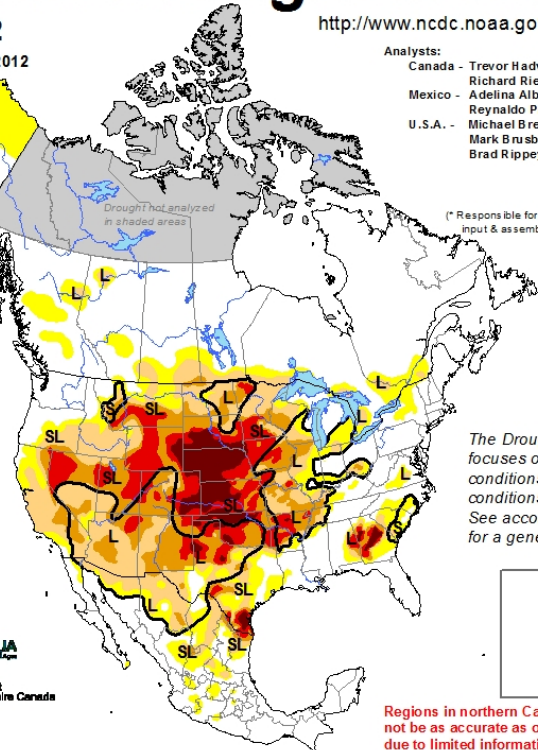
Analysts:  
Canada - Trevor Hadwen  
Richard Rieger  
Mexico - Adelina Albanil  
Reynaldo Pascual  
U.S.A. - Michael Brewer  
Mark Brubaker  
Brad Rippey

### Intensity

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

### Drought Impact Types:

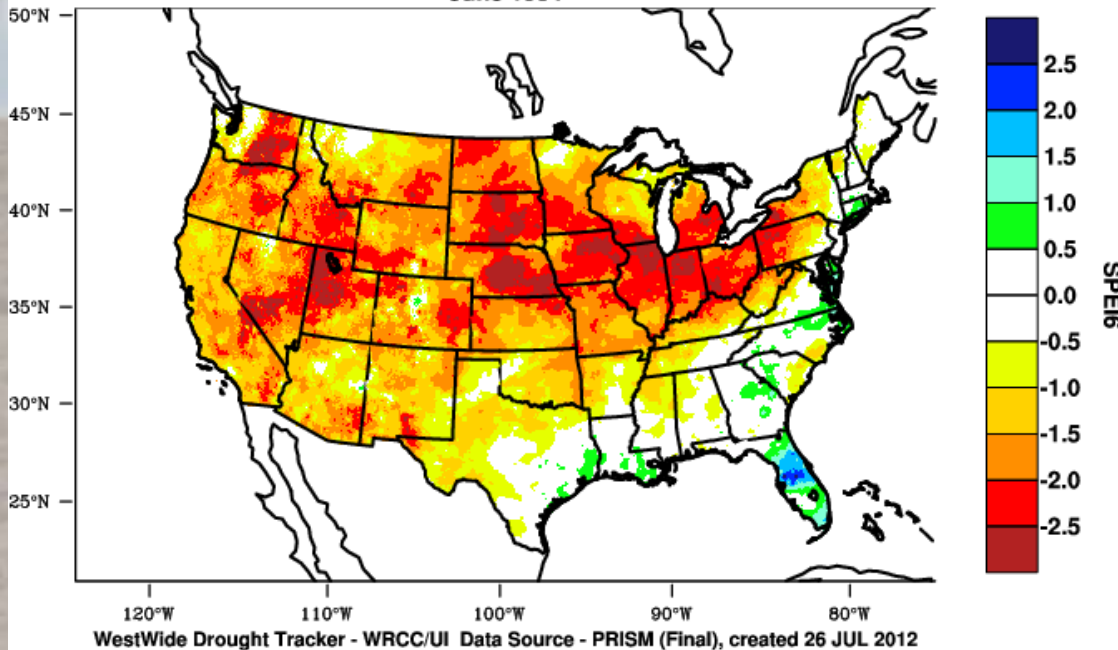
- ~ Delineates dominant impacts
- S = Short-Term, typically <6 months  
(e.g. agriculture, grasslands)
- L = Long-Term, typically >6 months  
(e.g. hydrology, ecology)





### Continental United States - 6 month SPEI

June 1934

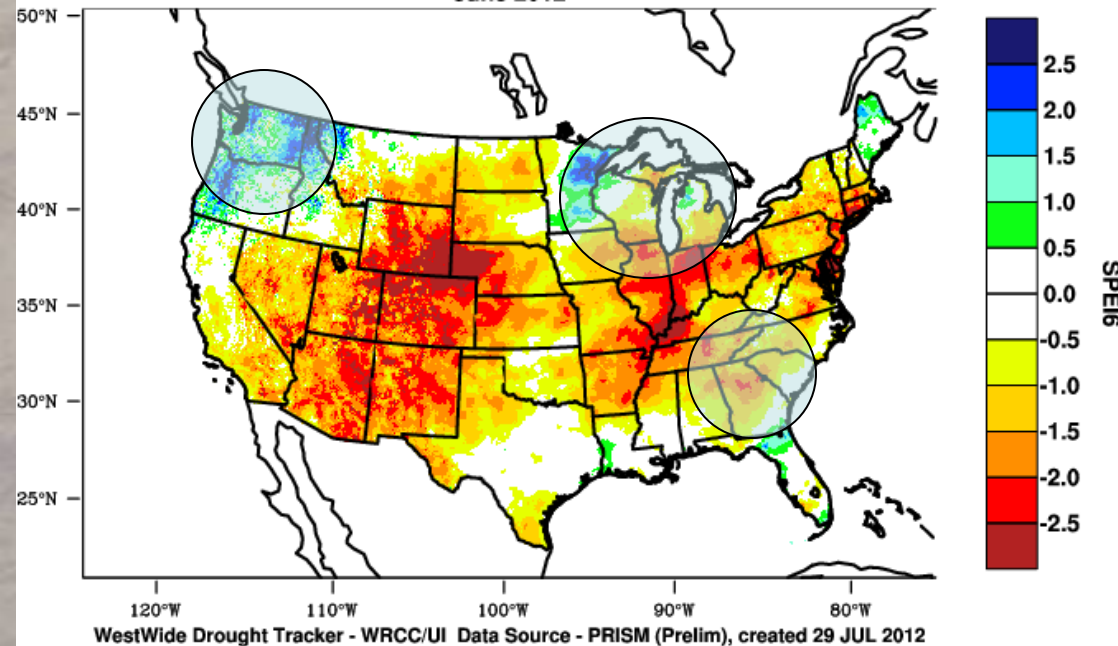


## Standardized Precipitation Evapotranspiration Index

1934 6-month  
through June

### Continental United States - 6 month SPEI

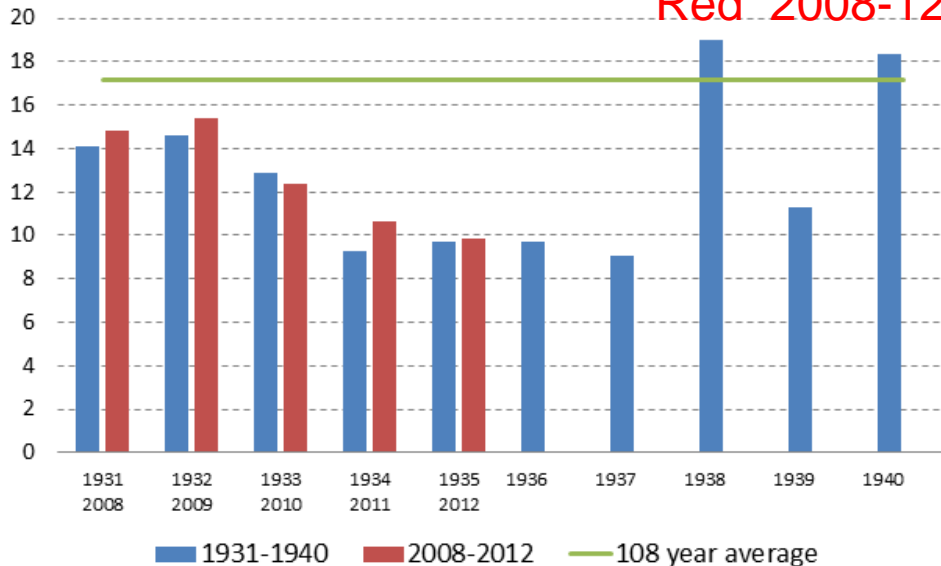
June 2012



2012 6-month  
through June

**Annual Precipitation  
Elkhart, Kansas**

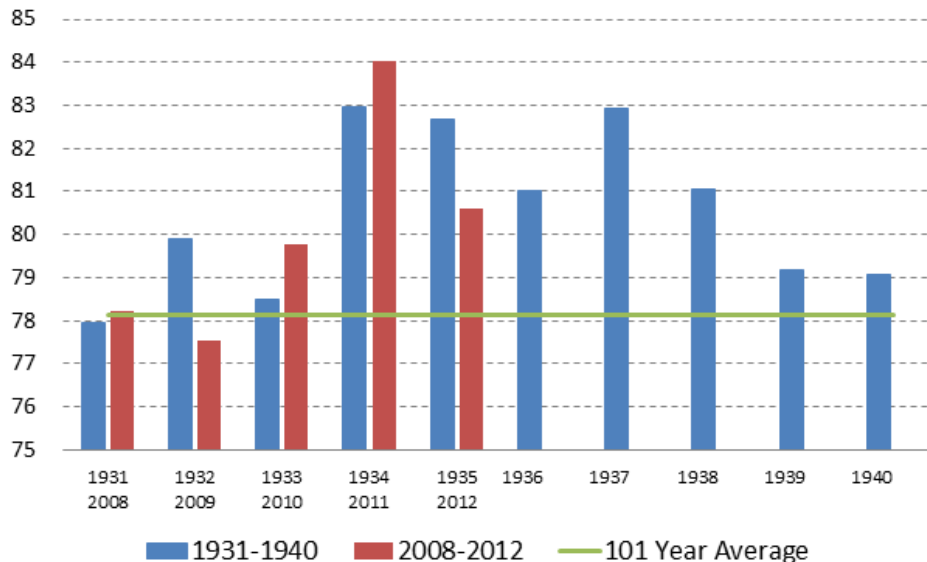
Blue 1930s  
Red 2008-12



**The drought has shown farmers the value of the Ogallala Aquifer and the need to make sure it is available into the future.**

.....Following stakeholder input, the Ogallala Aquifer Advisory Committee, KWA, KWO and KDA-DWR developed recommendations which became the Governor's 2012 water policy legislation.....

**July - August Temperature  
Elkhart, Kansas**

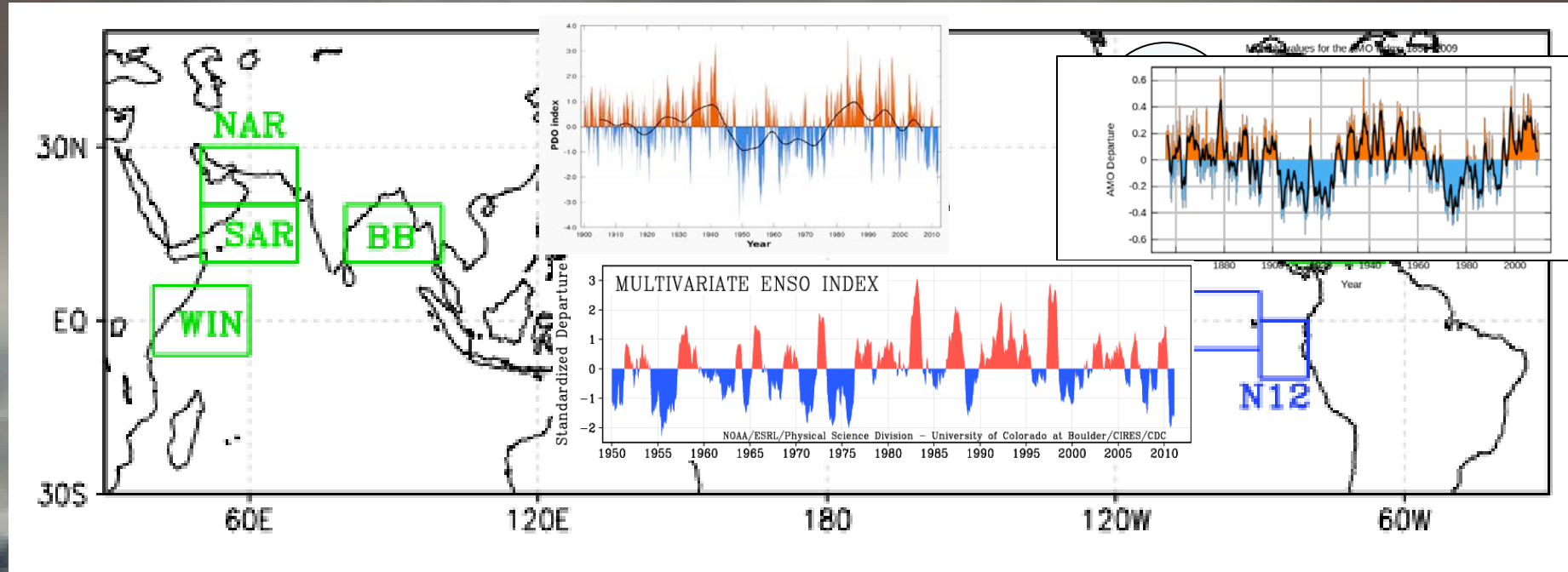


This approved Legislation is fundamental in changing from a culture of consumption to a culture of conservation in order to conserve and extend this vital resource that supports the entire western third of Kansas.

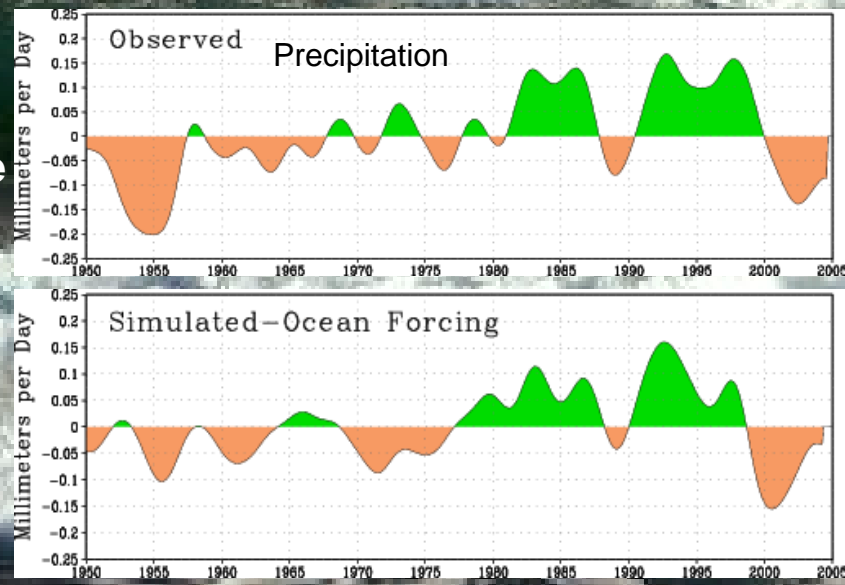
Gov. Brownback KS 2012  
T. Streeter KS Water Office



# Drought Early Warning-Useful monitoring regions for the US Southwest



Improved monitoring and projections of the ocean will be critical for the future predictions of drought in the semi-arid West.



# Summer 2012

## MANAGING DROUGHT IN THE SOUTHERN PLAINS

You are invited to join us in a webinar (web-based seminar) series to discuss drought conditions, impacts and resources available to help manage drought in the Southern Plains. Webinars will be held on the 2nd Thursday of each month at 10:00 A.M. Central Time. A shortened briefing will also be offered on the 4th Thursday. The content is geared toward a general audience – anyone who has responsibility to manage or assist others in managing drought and its related impacts.

If you would like to join in these webinars, you need to register via the SCIPP website: <http://www.southernclimate.org> or e-mail [scipp@monsonet.org](mailto:scipp@monsonet.org). For each webinar, you will receive an e-mail with the link to access the webinar. Each webinar will last 45-60 minutes.

Each webinar will include an overview of the current drought assessment and outlook, summary of impacts across the region, and a topic or resource, such as La Niña or wildfire conditions. You will have an opportunity to suggest topics for following webinars. The primary focus is in the states most heavily impacted from the current drought – Texas, Oklahoma and New Mexico – but participation from surrounding states is encouraged.

The webinar series is sponsored by a partnership of the National Integrated Drought Information System (NIDIS), National Oceanic and Atmospheric Administration (NOAA), National Drought Mitigation Center, Southern Climate Impacts Planning Program, Climate Assessment for the Southwest, and the region's State Climatologists.

Information from the webinars will be posted on a website linked through <http://www.southernclimate.org>. A two-page summary will be produced and posted for each webinar. Please pass on this announcement to relative organizations or groups that are involved in managing or monitoring drought and its related impacts.

To register or for more information, contact:

### The 2012 Drought in Colorado, Utah and Wyoming

A July 2012 update from the Western Water Assessment and the National Integrated Drought Information System.

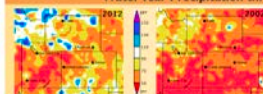
Under a second winter of La Niña, drought conditions continued to worsen through the 2012 water year, with low snowpack melting out early during a very dry and warm spring. Spring and early summer rainfall over most of the region was well below average, with flows similar to 2002 and other low-flow drought years. Continued dry and hot conditions in June dried out vegetation and led to very large and intense wildfires in all three states, along with widespread crop losses, pasture, and dried-out crop losses.

#### Drought Conditions as of early July



US Drought Monitor for July 10, 2012 (left) and July 9, 2002 (right). (Source: [www.droughtmonitor.unh.edu](http://www.droughtmonitor.unh.edu))

#### Water Year Precipitation through June



Percent of average (1981-2010) precipitation for the current water year to date, October 2011-June 2012 (left), with October 2001-June 2002 (right) for comparison. (Source: NWS COOP and DROTEL data, Gary Bates, NOAA ES&P, Physical Science Division)

#### Spring and Early Summer Temperatures



March-May 2012 temperatures in 2012 (left) were 2° to 3° above normal across the 3-state region, much warmer than the same period in 2002 (right). (Source: NOAA ES&P, Physical Science Division, Climate Analysis Branch, posted from NOAA NCEP Reanalysis data. <http://www.es&p.noaa.gov>)

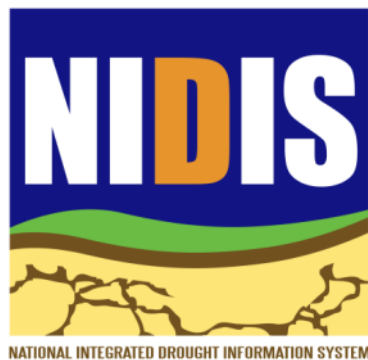
For an expanded version of this overview, including additional graphics and text, see the Special Issue of the Western Water Assessment Interannual West Climate Summary at [www.cccr.statecolorado.edu/WWCIS2012\\_July.html](http://www.cccr.statecolorado.edu/WWCIS2012_July.html)

[http://ccc.atmos.colostate.edu/drought\\_webinar\\_registration.php](http://ccc.atmos.colostate.edu/drought_webinar_registration.php)

## Central Region Drought Outlook 20 September 2012

Jenniss Today  
South Dakota State Climatologist  
South Dakota State University  
August, 2012  
[jis.today@sdsdstate.edu](mailto:jis.today@sdsdstate.edu)  
688-5141

Corn near Beresford, SD—9 Aug. 2012  
Author photo



NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM

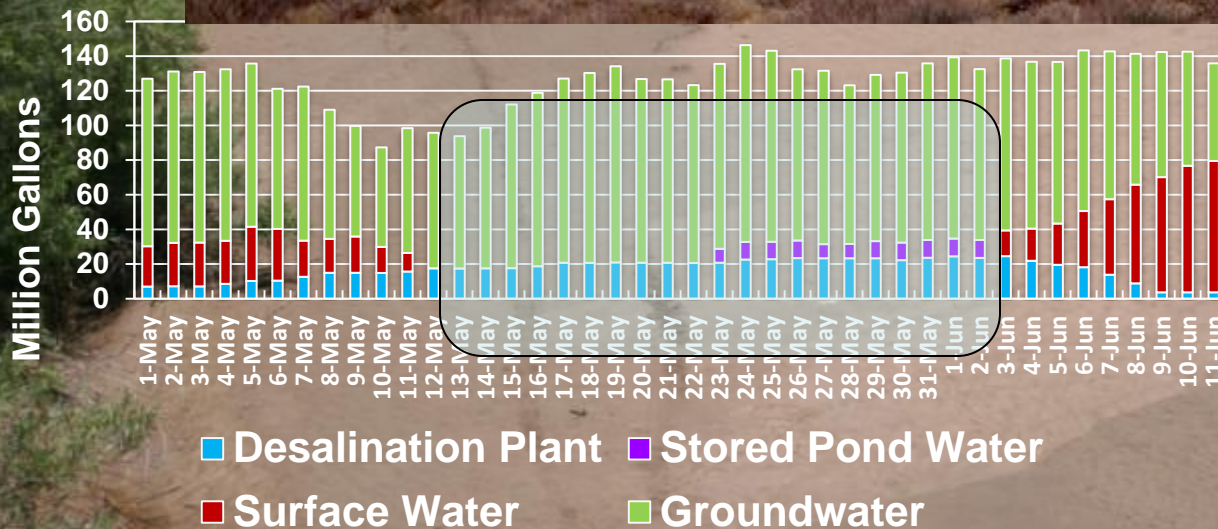
## NIDIS - UPPER COLORADO BASIN PILOT PROJECT

# Weekly Climate, Water & Drought Assessment



# Rio Grande Runs Dry

The fight for water in New Mexico  
New York Times, 27 March, 2013

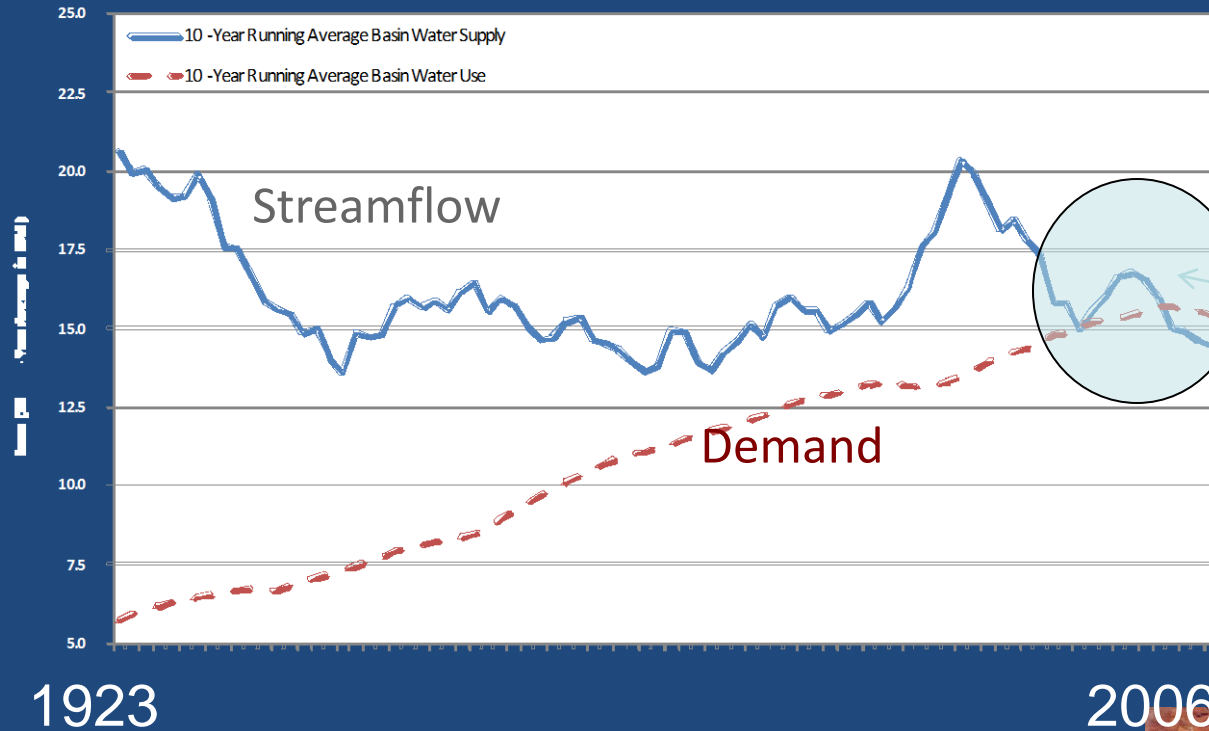


El Paso Water  
Utilities Board

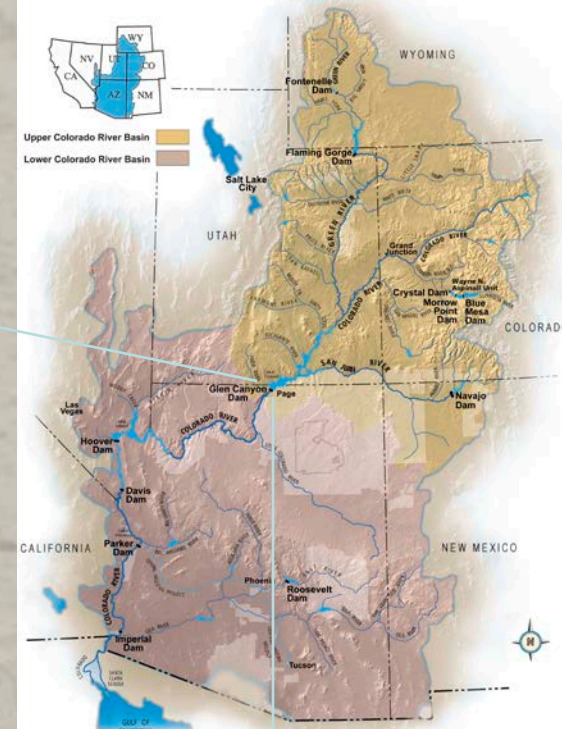


# Colorado River Water Supply & Use

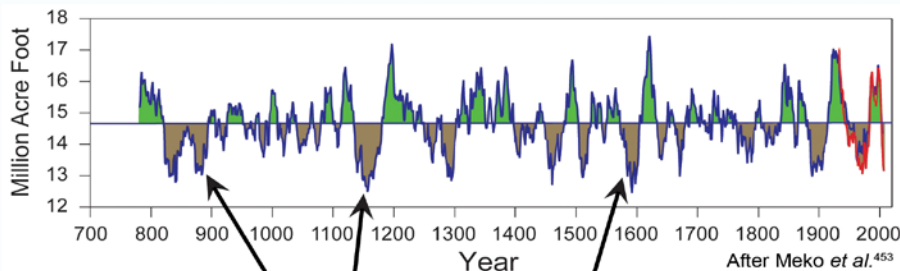
Colorado River Basin Water Supply and Water Use  
10 - Year Averages from 1923 to 2006



Colorado River Basin



750-2005

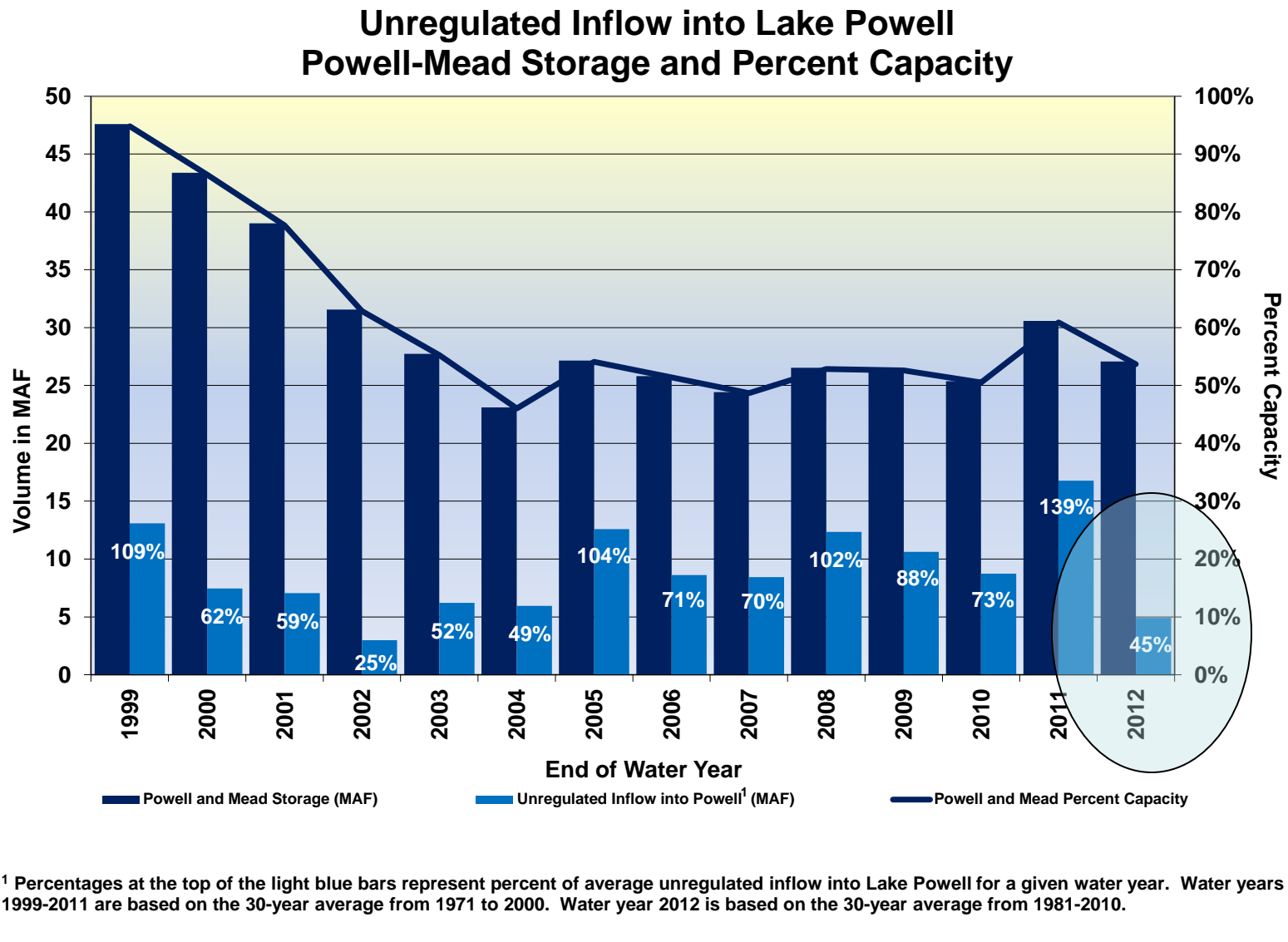


Some droughts in the past have been more severe and longer lasting than any in the last century.



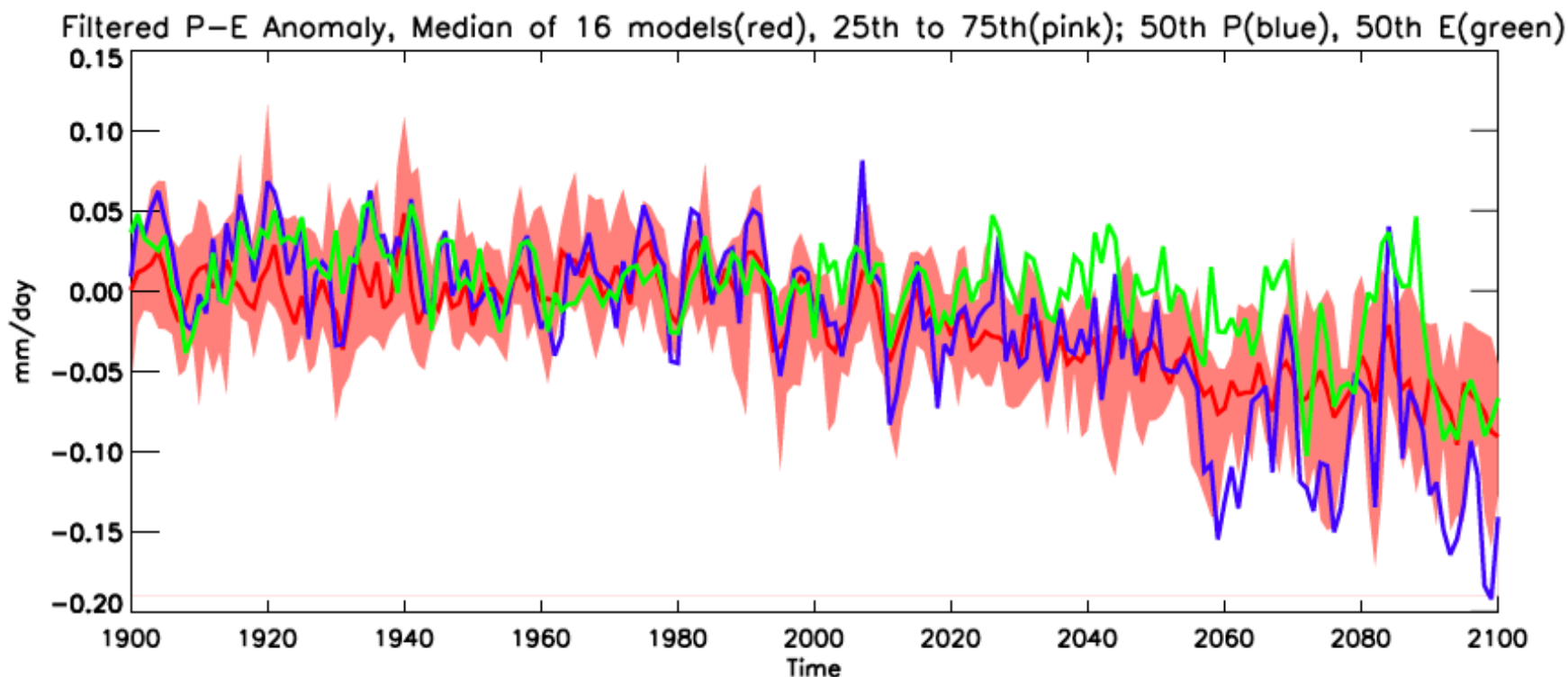


# State of the System (Water Years 1999-2012)<sup>1</sup>



In the Colorado River's 100-year recorded history, 1999 through 2010 ranks as the second-driest 12-year period

# $P$ , $E$ and $P-E$ averaged across all of SW North America in the IPCC AR5 global climate model simulations and projections for 1900 to 2100



Ongoing transition to a drier climate driven by decreasing precipitation



# Landscape changes- Tribal Lands in the Four-Corners Region (USGS, NIDIS)

**Sand Dune Mobility =  $W/(P/PE)$**



***Stable Sand Dunes***  
 **$= P/PE > 0.31$**



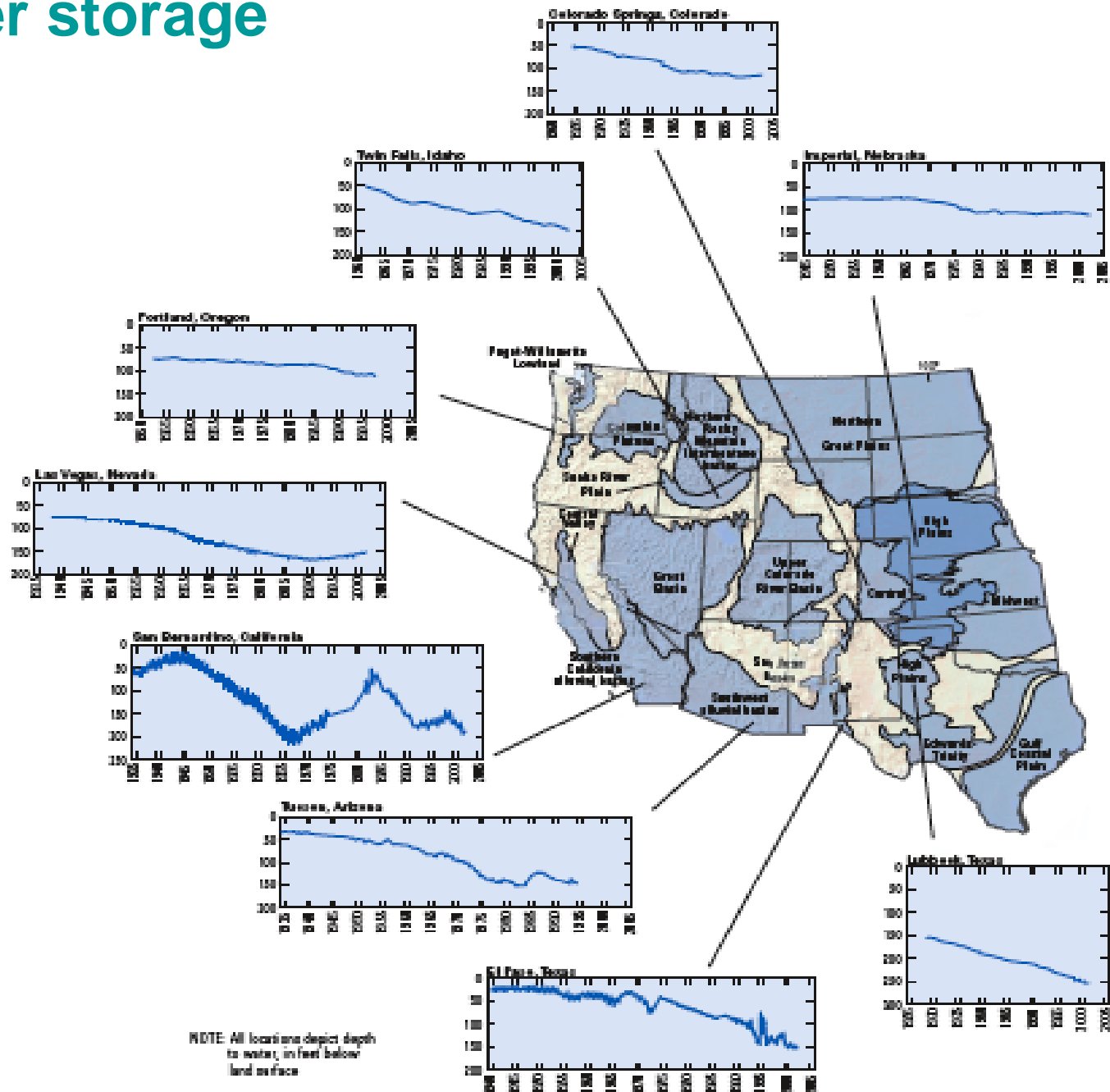
***Partly Active Dunes***



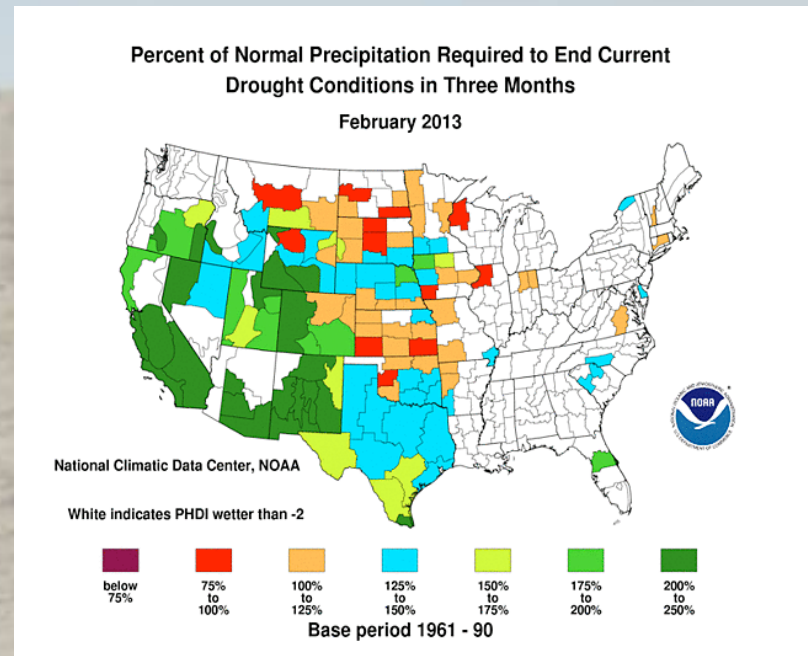
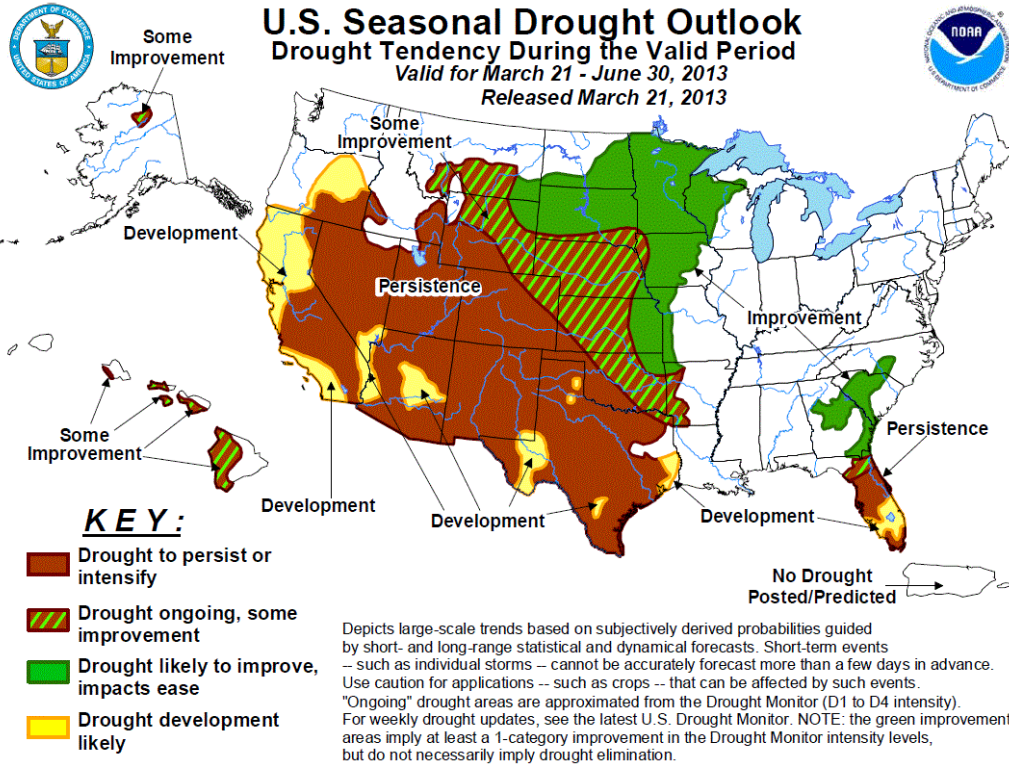
***Fully Active Dunes***  
 **$= P/PE < 0.125$**



# Aquifer storage trends







Drought is forecast to persist for much of the West and expand across northern California and southern Oregon

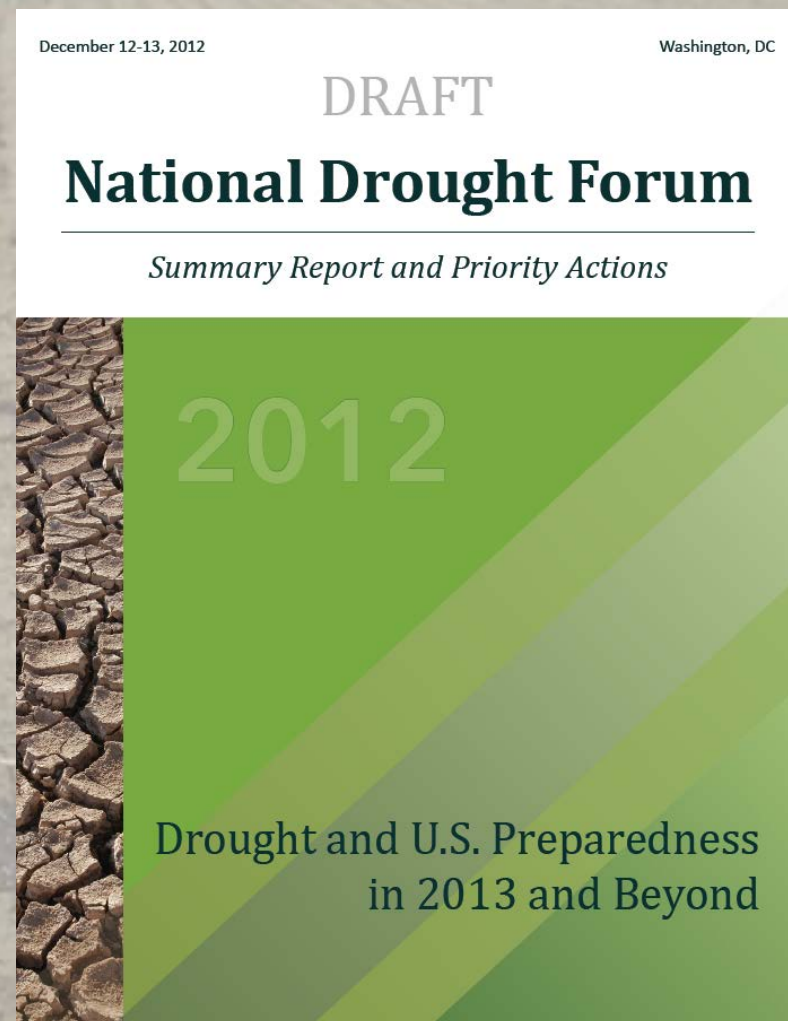
Prospects for improvement decrease further south across the southern high Plains and Texas

Persist or develop across the Florida peninsula-likely short-lived as the rainy season typically begins during June

# Goals

*“To understand the extent of 2012 drought impacts and response in 2012, and help provide new information and coordination for improving the nations’ drought readiness for 2013 and in the future”*

- Increase public awareness of this year’s drought and potential impacts for next year
- Technical assistance
- Ensure sustained support for monitoring, streamgages and other data
- Outreach with impacted communities
- Conservation plans





United States Senate Committee on  
**AGRICULTURE  
NUTRITION  
& FORESTRY**

Time 09:30 AM  
Location 328A  
Russell Senate  
Office Building

**Opening Statement of Chairwoman Debbie Stabenow (D-Mich)**

**Drought, Fire and Freeze: The Economics of Disasters for America's Agricultural Producers**

**February 14, 2013**



Witnesses:

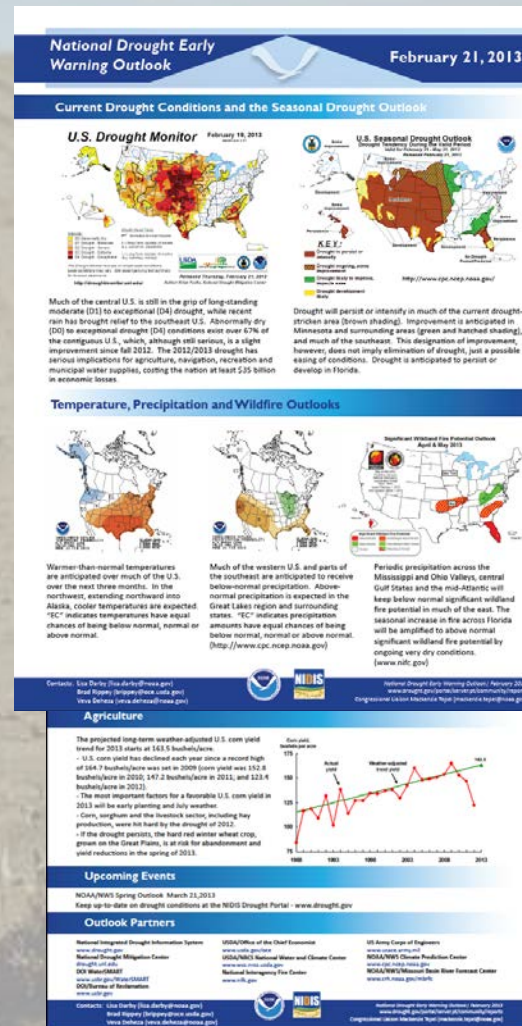
Dr. Joe Glauber, chief economist,  
USDA;

Dr. Roger Pulwarty, NIDIS, NOAA

Leon LaSalle, rancher, Havre, MT;

Anngie Steinbarger, farmer, Edinburgh,  
IN;

Jeff Send, cherry farmer, Leelanau, MI.



# National Governors Association Meeting 24-27 February, 2013

## MOU Between DOC and USDA



### MEMORANDUM OF UNDERSTANDING BETWEEN THE U.S. Department of Commerce AND THE U.S. Department of Agriculture



# NIDIS EVALUATION SURVEY



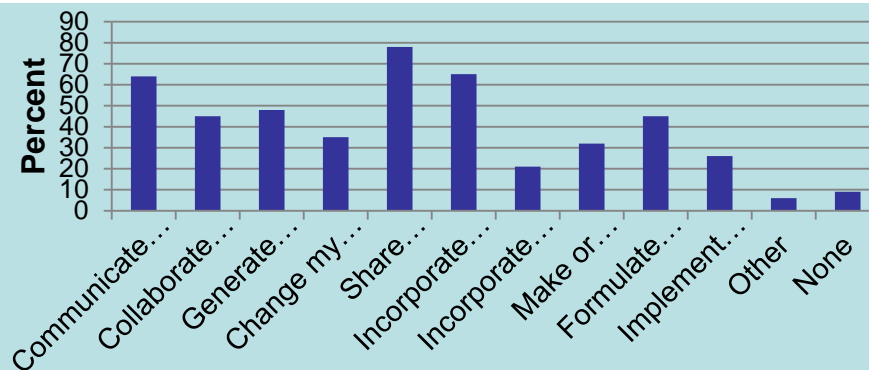
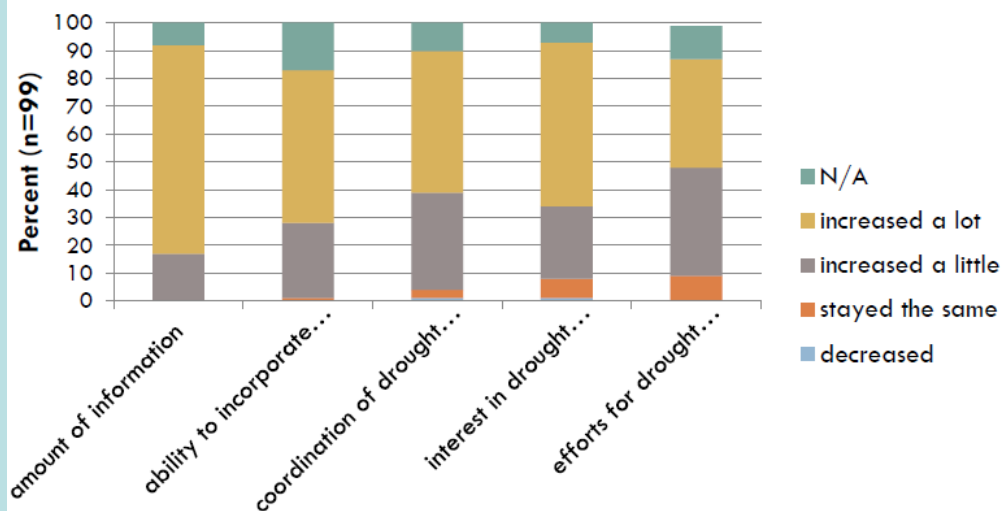
9/17/2012

Executive Summary

## Drought-Ready Communities A Guide to Community Drought Preparedness

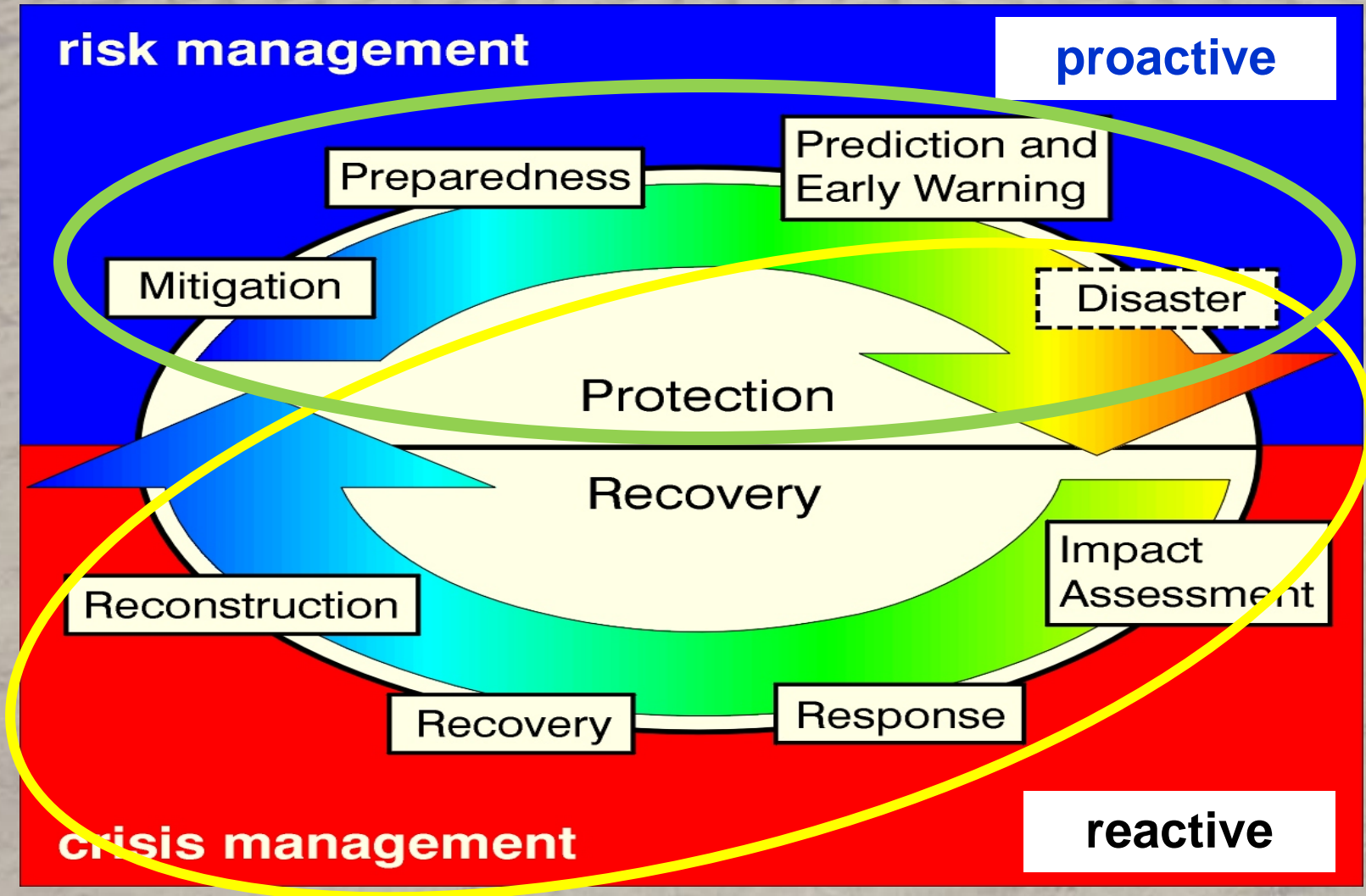
ulate outside of NIDIS  
gation Center. Comments,  
'onya Haigh, NDMC,

## Compare your readiness for drought before 2002 with today



# The Cycle of Disaster Management

Risk management increases coping capacity, builds resilience.



Crisis management treats the symptoms, not the causes.



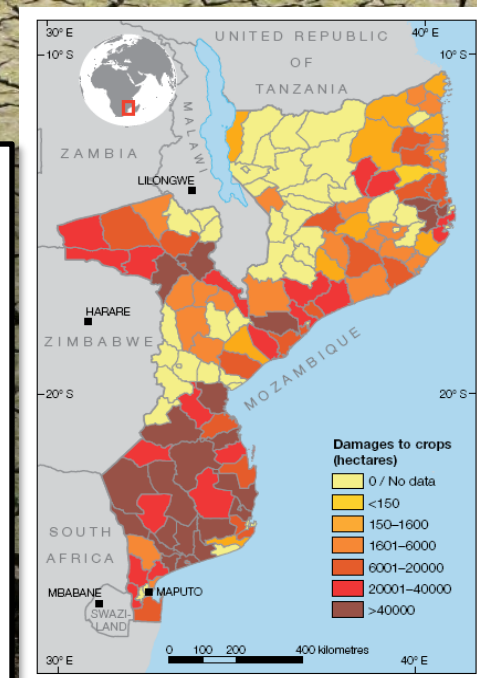
# “Paradoxes”

- Cumulative reduction of smaller scale risks..... may increase vulnerability to large events or rapid transitions -Risk models fail just when they might be most heavily
- Markets allow flexibility for adjustment to risks in hydrological uncertainty---Meeting other public values especially remain difficult
- Planning.....“action” only after crisis or focusing event i.e. unwilling to accept short term smaller pain to stave off longer-term severe pain
- Decentralization..... But give us better coordination. National vs. States vs. watershed vs community priorities: Jurisdictional externalities
- Oh-yeah-and **that “environment thing”**...get us that too

# Drought remains a hidden risk

Most estimates of disaster losses exclude indirect losses - livelihoods and informal economies, and intangible losses including ecosystem services, quality of life and cultural impacts.

In some areas drying due to climate change will be overlaid on the periodic droughts those areas have always experienced!

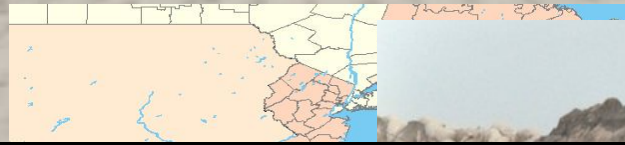


Short-term actions do not always provide long term risk reduction-can reduce or increase longer-term risks

For exposed and vulnerable communities, even non-extreme weather and climate events can have extreme impacts

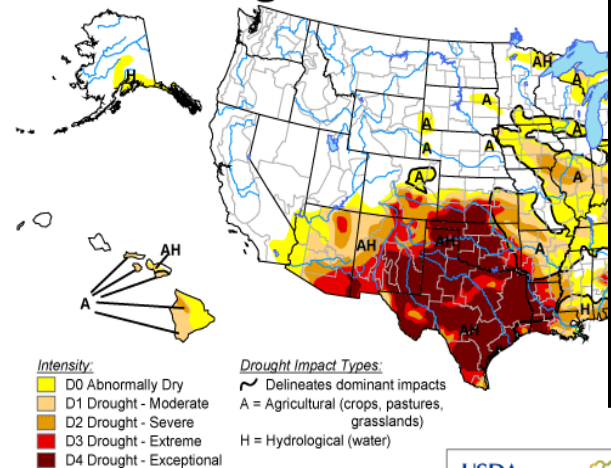


# “Hurricane Sandy Exposes Creaky American Infrastructure”: Single event vs cumulative risks



## U.S. Drought Monitor

Aug



The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

<http://drought.unl.edu/dm>

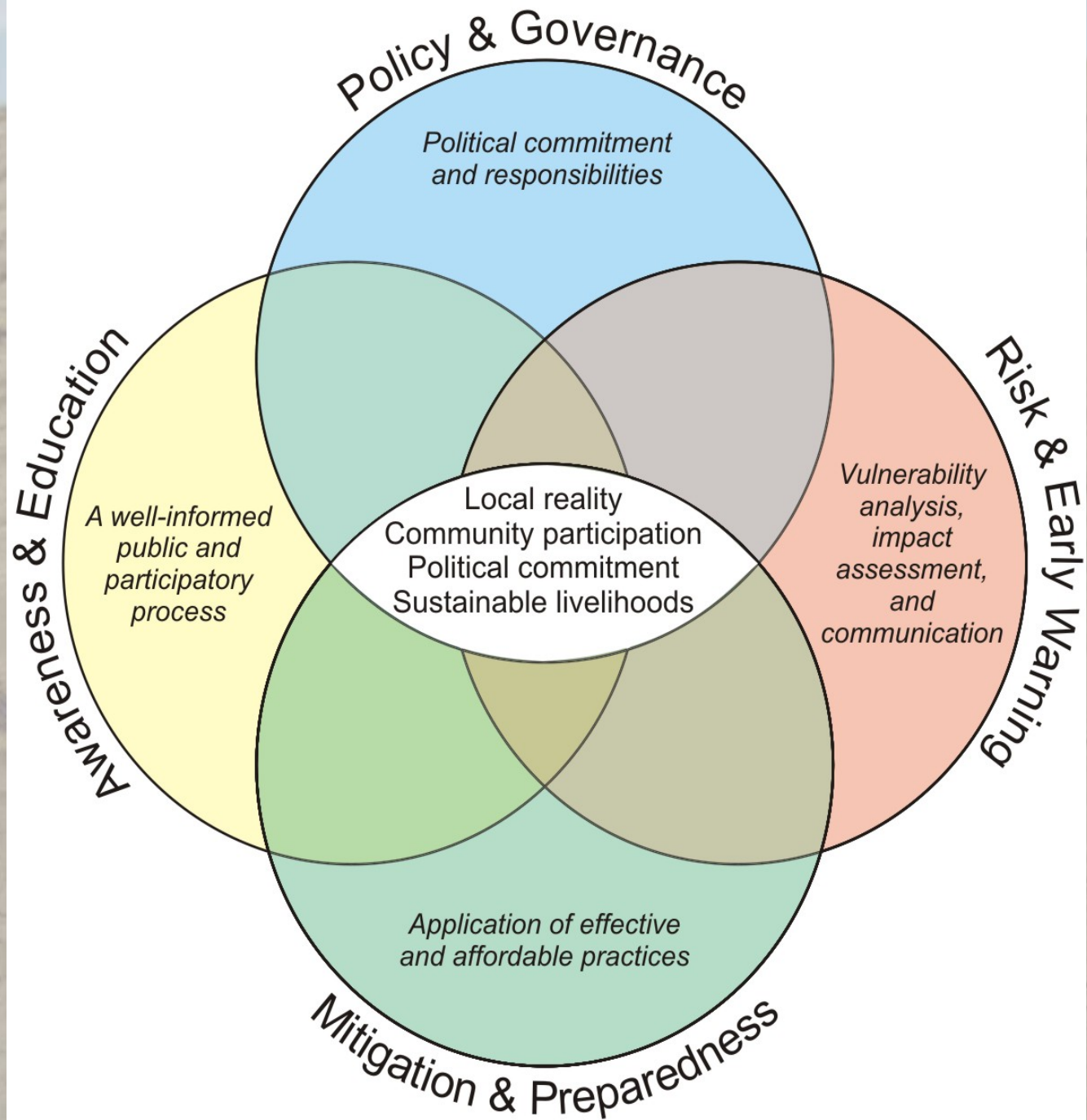
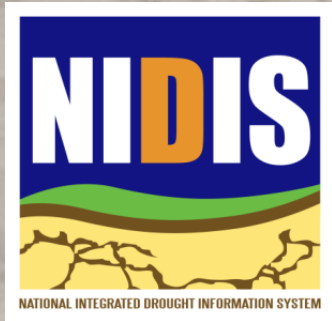


Released Thursday, September 1, 2011

Authors: Eric Luebehusen, U.S. Department of Agriculture



# Principal Elements of Drought Risk Reduction Framework



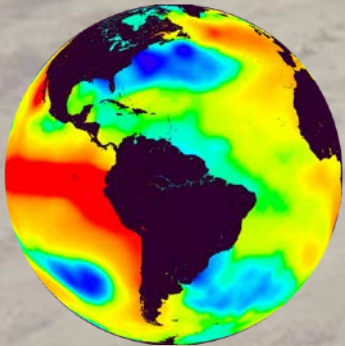




# OVERCONFIDENCE

This is going to end in disaster, and you have no one to blame but yourself.

**THANK YOU!**



<http://go.funpic.hu>





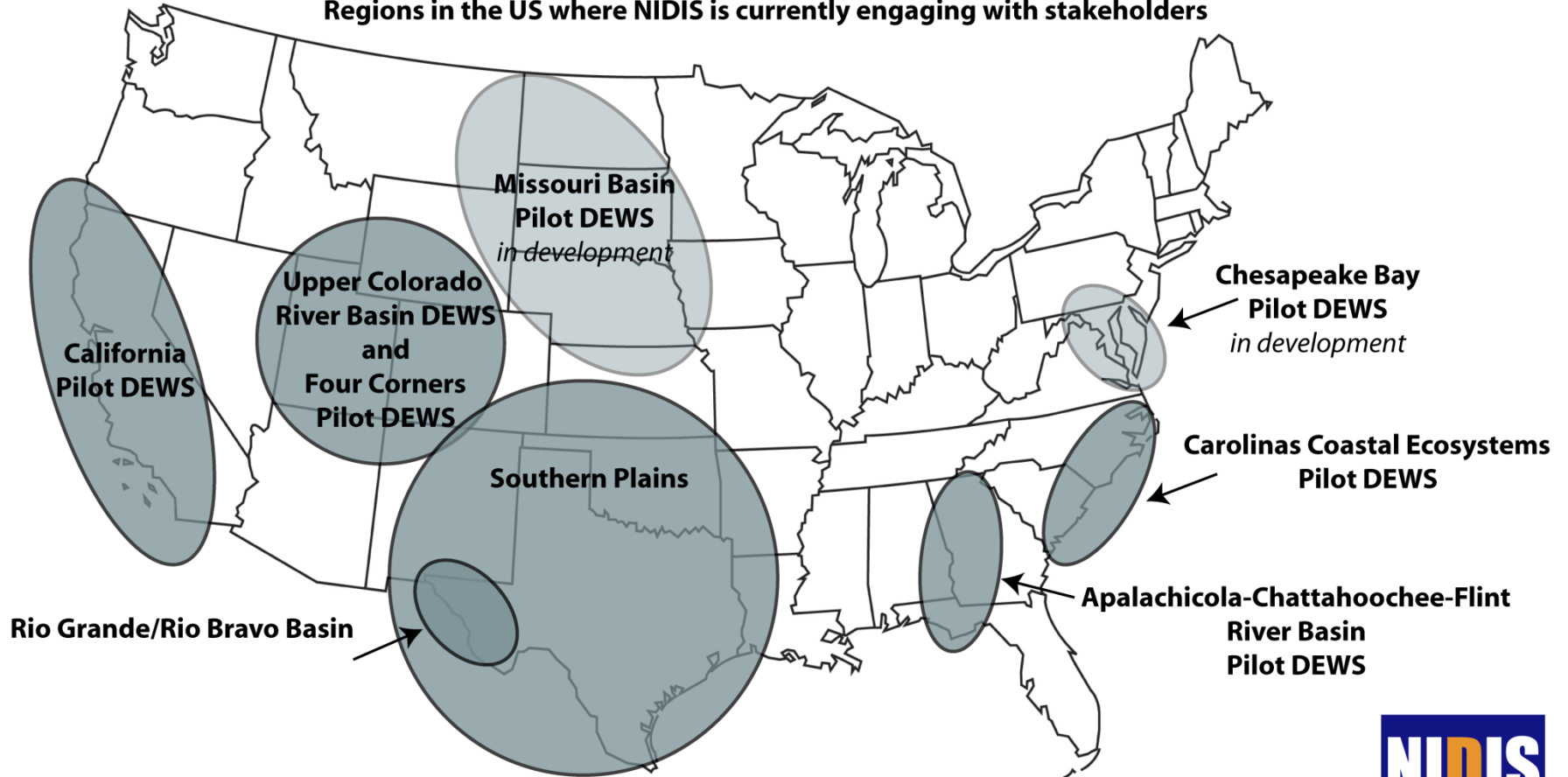
# Iowa Drought Actions 2012

- **Coordination between state government and partners in private sector**
- **Suspension of state laws to assist agriculture producers**
- **Rural water systems monitoring**
- **Burn bans issued for 2/3 of Iowa**
- **Aflatoxin watch**
- **Water allocation statute**



## National Integrated Drought Information System (NIDIS)

Regions in the US where NIDIS is currently engaging with stakeholders





**Extremes in a changing climate**-Adaptation research?  
**How does new information relate to what is already known?**  
**How often should criteria for “robustness” be reconsidered?**

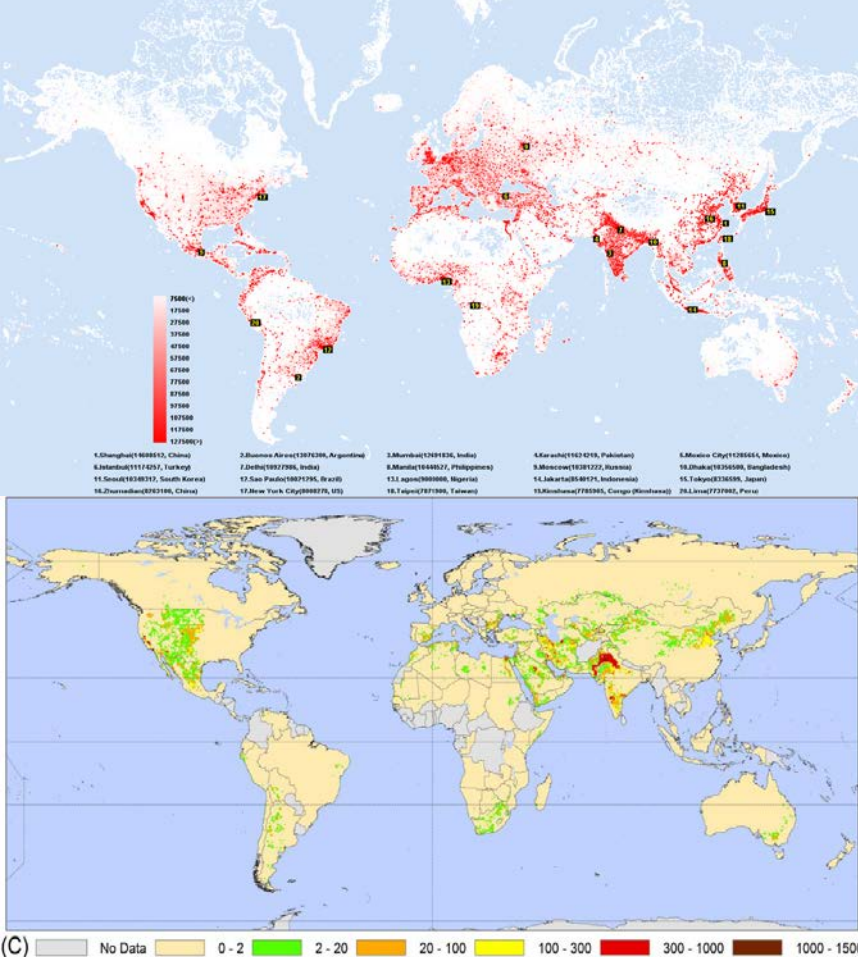
Understand many adaptations as being driven by crises, learning and redesign- Role of “surprises” in shaping responses  
Generate risk profiles and a portfolio of measures-identifying the broader economic, social and environmental benefits of each measure along with its cost

Develop information systems for critical thresholds across climate time and space scales:

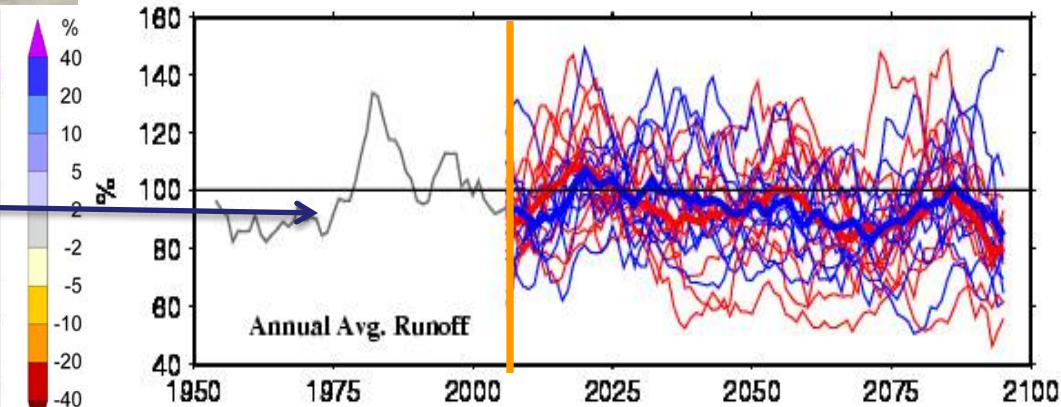
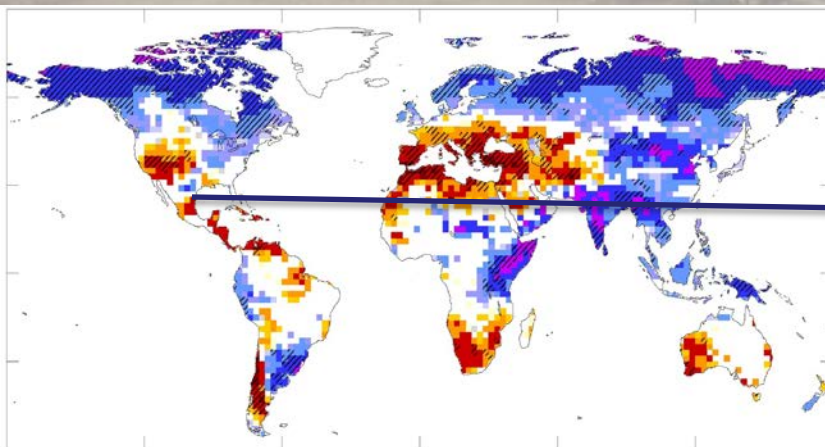
- Place multiple indicators within a statistically consistent triggering framework-cross-correlation among units before a critical threshold
- Scenario planning to address problem-definition and characterize multiple uncertainties-technical as well as institutional capacity

Are the assumptions about planning borne out by what we know from the climate record and projected conditions?

Many potential futures



(C) No Data 0 - 2 2 - 20 20 - 100 100 - 300 300 - 1000 1000 - 1500





# Governing climate risk assessment and management



**Accountability**- CRM needs to be located in a department, preferably with planning oversight and some fiscal responsibility-provide political authority and policy coherence across sectors. **Emergency management organizations can rarely play that role.**

**Efficiency**- only occurs when CRM is carried out in partnership with at-risk households and communities and organizations that represent them. Benefits are cost-effectiveness, sustainability, citizenship and social cohesion.

# Are we better off?

- The number of states, communities, and institutions with improved capacity to inform drought risk management:  
....regional drought information coordinator
- The number of staff in or working with institutions trained to develop and communicate local drought information and help reduce impacts
- The number of research projects that conduct and update drought drivers, impacts and user needs assessments in drought-sensitive parts of the US
- The percentage of the U.S. population covered by adequate climate risk and early warning information systems



Grains and oilseeds dominate the southbound traffic, accounting for roughly half of the nearly 80 million metric tons of cargo (22 percent of which is coal) moving southward through this section of the river. Twenty percent of the northbound traffic is coal, 21 percent is from the fertilizer sector



The Corps of Engineers'- Low water levels December through February for this section of the Mississippi between -6.5 and -7 feet -- well below the level for minimum navigation

Some spring snowmelt flooding northern Missouri tributaries...but less than normal

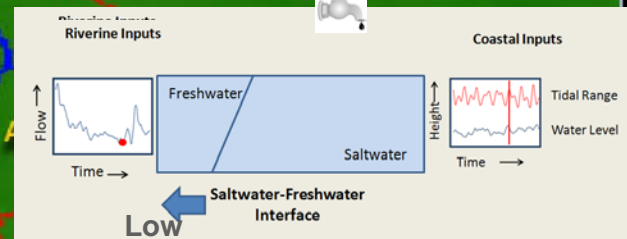
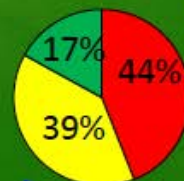
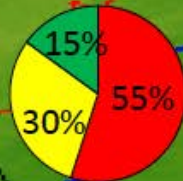
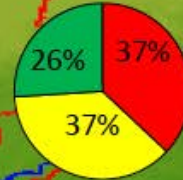
Missouri navigation season flows 50% chance- less than 201<sup>39</sup><sub>12</sub>

# 3-Month Mean Daily Streamflow Forecasts Apalachicola Watershed Southeast River Forecast Center

March 10<sup>th</sup> – June 10<sup>th</sup>  
2013



ID	Below	Above
CMMG1IN	2672	3520
WHTG1	5000	6733
LOVG1	179	239
ABNG1	6472	9469
BLOF1	29485	40122



Tidal Marshes  
Critter Communities





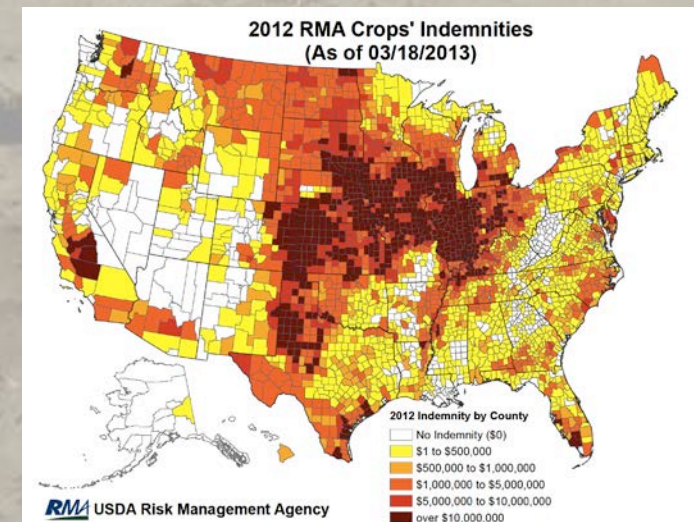
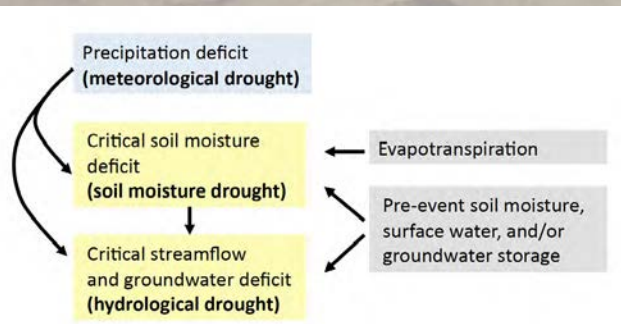
# Why do some places have more drought and water scarcity than others?

- Just barely enough rain, and large variations from place to place
- Rainfall tied to sea surface temperatures: ENSO, Pacific Decadal Oscillation, Atlantic Multidecadal Oscillation
- Water demand equals or exceeds water supply
  - California
  - Southwest US

# Monitoring and Prediction for Drought and Outlook for 2013

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NOAA/NIDIS

S. Schubert NASA  
D. Miskus NOAA/CPC, J. Verdin USGS,  
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N. Doesken CO, A. Steinemann CA  
NIDIS Implementation Team,  
Interagency Drought Task Force





# NIDIS Drought Information Partners: (Federal, States, Tribes, Urban, other)



## Monitoring & Forecasting



## Drought Impacts Assessments and Scenarios



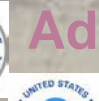
## Early Warning Information in support of drought risk management



## Communication and Outreach



## Engaging Preparedness & Adaptation



# Predictability (DTF, NIDIS)

**Current Skill**

**User Needs**

